DEVICE FOR REGULATING ROTATIONAL SPEED OF THE DRIVEN ROTOR OF A VISCOSITY COUPLING

TECHNICAL FIELD

[0001] The invention relates to a device for regulating the rotational speed of the driven rotor of a viscosity coupling of a motor vehicle cooling system, in particular of a fan of the cooling system.

BACKGROUND OF THE INVENTION

[0002] In motor vehicle cooling systems, viscosity couplings, that is to say liquid friction couplings, are employed, to couple driven parts of the cooling system, in particular a fan, to the vehicle engine and drive them by means of the latter. To keep the rotational speed of the driven rotor of the viscosity coupling, for example the fan, at an optimal value, the quantity of effective shearing liquid supplied to the viscosity coupling is controlled by way of a setting unit, for example a valve.

[0003] U.S. Patent No. 6,079,536 discloses regulating the rotational speed of the driven rotor of a viscosity coupling by means of a regulator that supplies the setting unit with a setting signal dependent on a measured actual rotational speed.

[0004] The object of the invention is so to improve known devices and to achieve higher dependability in operation.

[0005] This object is accomplished according to the present invention.

SUMMARY OF THE INVENTION

[0006] According to an embodiment of the invention, the rotational speed of the driven rotor of the viscosity coupling is regulated, in the first place, in a control circuit ("closed loop control") in known manner, the measured actual rotational speed being regulated to a preassigned target speed. In addition to this control circuit, the rotational speed can also be controlled to the preassigned target speed ("open loop control"). For this purpose, the setting unit is supplied with the setting signal by way of a switch unit switchable between two positions. In the first position of the switch, the setting unit is supplied with

the setting signal of the regulator, so that the rotational speed of the driven rotor is regulated to the preassigned value. In the second switch position, the setting unit is supplied with a preassigned setting signal, so that the rotational speed is controlled to the preassigned target value, without any feedback of a measured actual speed. The switch unit switches automatically into the second position when no measurement of the actual speed of the driven rotor is present.

[0007] The device according to this embodiment of the present invention results in an improved operating dependability of the cooling system. So long as the operation of the circuit is trouble-free, the rotational speed and with it the cooling of the system is regulated to the preassigned optimal value. If the actual speed value drops out, for example because the sensor measuring the actual speed is defective, then the device switches from regulation to control, so that continued function of the cooling system is assured even if not regulated exactly to optimum conditions.

[0008] In many applications, such as are described for example in U.S. Patent No. 6,079,536 as well, a cascaded regulation of the viscosity clutch takes place. In a first temperature regulator, a target speed is calculated from the measured actual temperature of the cooling system and the operating conditions of the vehicle engine. A following speed regulator regulates the actual speed of the driven rotor of the viscosity clutch to the target speed. In such an embodiment, the invention results in the additional advantage that the calculation of the target speed can be carried out in the temperature regulator in exactly the same manner and with the same software, no matter whether there is a following speed regulation or not. If an actual speed measurement of the driven rotor of the viscosity clutch is present at the vehicle cooling system, then the speed is regulated by way of the regulator according to the invention. If the motor vehicle cooling system does not exhibit such an actual speed measurement, then the switch unit switches automatically into control mode, and the speed is controlled to the target value preassigned by the temperature control. The control circuit here remains out of operation. This offers the advantage to the engine manufacturer that the same device and the same

software may be employed for viscosity couplings having an actual speed measurement and for those without such an actual speed measurement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the following, an embodiment of the present invention will be illustrated in more detail in terms of FIGURE 1 by way of example. Figure 1 schematically depicts a device for regulating the rotational speed of the driven rotor of a viscosity coupling.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0010] The fan of a motor vehicle cooling system is driven by the vehicle engine by way of a viscosity coupling (liquid friction coupling). The rotational speed of the fan is regulated by the engagement of the viscosity coupling. For this purpose, the flow of shearing liquid supplied to the working chamber of the viscosity coupling, and hence taking effect, is controlled by way of a setting unit, for example a valve unit. The setting unit is controlled by a setting signal, in particular by a pulse-width-modulated (PWM) timed signal, to regulate the speed to the target preassigned by the temperature regulator.

[0011] As shown in Figure 1, a control diagram 12 is supplied with engine data, for example the engine speed 14 (input speed), and an engagement demand 16. By reference to the stored diagram 12, a pulse width-modulated target speed setting signal GPWM is calculated from these quantities. This target speed signal GPWM is supplied to an input 18 of a fast regulator 20, configured as a PID regulator. By way of another input 22, the regulator 20 is supplied with a speed deviation ("error speed") signal 24. This speed deviation signal 24 corresponds to the deviation of the actual speed of the driven rotor of the viscosity coupling as measured by means of a sensor from the GPWM target speed. The regulator 20 adapts the supplied setting signal GPWM by way of its P-, I-, D-function until the deviation ("error speed") is zero. This adapted setting signal is emitted by the regulator 20 by way of its output 26 as setting signal for the setting unit.

[0012] Ahead of the setting unit, a switch unit ("switch") 28 is arranged, comprising two switch positions. In a first switch position, the setting signal coming from output 26 of the regulator 20 is supplied to the setting unit. In a second switch position, shown in the drawing, the target speed setting signal GPWM of the diagram 12 is supplied directly by way of a by-pass line bridging over the regulator 20 to the setting unit.

[0013] The switch unit 28 is switched between the first switch position and the second switch position by way of a control input 30. For this purpose, the actual speed signal 32 ("fan speed") measured by the sensor at the driven rotor of the viscosity coupling is supplied to a difference operation amplifier 34 ("Rel. Operator"). The difference operation amplifier 34 ascertains by comparison with a null level whether an actual speed signal 32 is present or not. If the actual speed signal 32 is present, then the difference operation amplifier 34 switches the switch unit 28 into the first switch position, so that the closed control circuit of the regulator 20 becomes active, regulating the speed of the driven rotor of the viscosity clutch to the GPWM target speed. If the difference operation amplifier 34 finds no actual speed signal 32, then the difference operation amplifier 34 switches the switch unit 28 to the second switch position, in which the regulator 20 is by-passed and the setting unit is controlled according to the GPWM target speed of the control diagram 12.

[0014] If the viscosity coupling comprises a sensor for measuring the rotational speed of its driven rotor, then the speed can be regulated to the preassigned target value by way of the closed circuit of the regulator 20. If the sensor drops out, then the device automatically switches and controls the speed of the viscosity coupling to the preassigned target value. If the device addresses a viscosity coupling not comprising a sensor for measuring the actual rotational speed of the driven rotor of the viscosity coupling, then no actual speed signal 32 is found, and the device operates automatically without the circuit of the regulator 20.

[0015] While various embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to

those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.